

## **Annual Healthcare Spending Attributable to Cigarette Smoking**

### **An Update**

### **Appendix**

#### **Study Sample**

The final sample consisted of MEPS respondents who could be linked to the corresponding NHIS data file. Because MEPS respondents were drawn from the NHIS household samples within previous two years, for example respondents from 2006 MEPS were linked to those from the 2004 and 2005 NHIS. Female MEPS respondents who self-identified pregnancy at the time of the interview, as well as those who were younger than aged 18 years at the time of the interview were excluded from the analysis. The smoking-attributable maternal and child health care expenditures are available elsewhere.<sup>8,27,28</sup>

In primary specification, alcohol use was classified into four categories: non-drinkers, non-excessive drinking, excessive drinking, and unknown. Non-drinkers were those who consumed no alcohol in the past year. Non-excessive drinkers were those who consumed an average of up to 14 drinks per week for men or up to 7 drinks per week for women, and who never had 5 or more drinks in a single day during the past year. Excessive drinkers were those consumed an average of more than 14 drinks per week for men or more than 7 drinks per week for women and/or had 5 or more drinks in a single day once or more during the past year. In a sensitivity analysis, alcohol users were classified into two groups: non-drinkers and drinkers.

Body weight measurement includes four categories: underweight, normal weight, overweight, and obese. Underweight included those whose BMI was less than 18.5; normal weight included those whose BMI was greater than or equal to 18.5 but less than 25; overweight included those whose BMI was greater than or equal to 25 but less than 30, obese included those whose BMI was greater than or equal to 30. All analysis used the appropriate design variables and the weighting variables to account for the complex survey design of the 2006-2010 MEPS (perwt06f-perwt10f).

Besides body weight and alcohol use, it has been well documented in the literature that smoking is closely associated with other risky behaviors.<sup>1-8</sup> It has been widely hypothesized as individual's attitudes toward risk taking, that is smokers are more likely to be risk takers and thus are more likely to be involved in other risky behaviors. Table 1 of the manuscript also provides some evidence of the connection between risky behaviors or attitudes toward risk taking and smoking. For example, compared to never smokers, current smokers were more likely to have no health insurance, have no flu shot, not wearing a seat belt, or being more likely to take risks. As a result, attributing all of the differences in health care spending between smokers (current or former) and never smokers to smoking, alcohol use, body weight, and socialdemographic factors would be incorrect, as the two groups also differ in attributes of other risk taking. A more appropriate comparison is between current or former smokers and never smoked but who otherwise have the same characteristics as smokers, which should include other risky behaviors or attitudes toward risk taking. Therefore, in order to construct an appropriate comparison group for smokers from a group of people who have never smoked but who otherwise have the same characteristics as smokers (essentially nonsmoking smokers), in addition to control for individual

socio-demographic factors in the regression, a set of covariates of other risky behaviors and attitudes toward risks were also included.

### **Cross-sectional approach and longitudinal approach**

The cross-sectional approach and the longitudinal approach are the two major methods used to estimate the smoking attributable health care spending. The cross-sectional approach, including the two-part model used in this analysis, is often used to evaluate the aggregate attributable health care spending at a given time, such as within a year, while the longitudinal approach is used to assess the lifetime attributable health care expenditure of having one additional smoker in the present value. Each of these two approaches has its own benefits and limitations. For example, the longitudinal approach is able to forward looking of financial burdens of cigarette smoking. It can also be used to assess smoking attributable health care expenditures associated with initiation, cessation, and consumption reduction in a net present value. However, the longitudinal health care expenditure data is rare and usually containing small sample size, which limits the possibility to perform sub-population analysis. Moreover, in order to perform lifetime analysis, a set of assumptions about future events are necessary, including medical technological advances, changes in real prices of medical services, and disease progression rates. The cross-sectional approach can provide a snapshot of smoking attributable health care expenditures in the population. The data for cross-sectional studies are also relatively easy to obtain. However, the robustness of the estimation of the cross-sectional approach depends on controls of confounders related to cigarette smoking and health care spending. This is particularly true for all causes approach, the approach used in this analysis. Alternatively, in disease-specific approach, the validity of the estimates largely depends on the reliability of disease-specific relative risks. A

summary on the comparison of the cross-sectional approach and the longitudinal approach used for smoking attributable health care spending can be found in the 2012 CBO report.<sup>7</sup>

**Appendix Table 1.** Percent annual health care spending attributable to cigarette smoking, by smoking status – 2006-2010

Smoking Status	Prevalence (%)	Percent Attributable Fraction (95% CI) <sup>a</sup>
Current smokers		
0-14 cigarettes per day	11.4	1.5 (0.8-2.2)
15-24 cigarettes per day	7.5	0.9 (0.3-1.5)
25+ cigarettes per day	2.7	0.9 (0.4-1.4)
Former smokers		
who quit within the last 5 years	6.0	1.5 (0.7-2.2)
who quit more than 5 years ago	16.6	4.0 (2.2-6.0)
Total		8.7 (6.8-11.2)

<sup>a</sup>The sum of individual categories may not equal the total because of rounding. Bootstrapped 95% CIs are shown in parentheses.

Appendix Table 1, which corresponds to the first sensitivity analysis described in the manuscript, reports the estimates by smoking intensity among current smokers. These results indicate that although the smoking prevalence of heavy smoking, which is defined as smoking 25 or more cigarettes per day, was low, approximately 3 times lower than the prevalence of smoking 15-24 cigarettes per day (2.7 versus 7.5), heavy smoking contributed to almost 1% of health care expenditures among the U.S. adults, which is the same as the attributable fraction of those who smoked 15-24 cigarettes per day. This finding demonstrates that heavy smoking was associated with disproportionately higher per person attributable health care expenditures.

**Appendix Table 2.** Percent annual health care spending attributable to cigarette smoking, aged 18-65, by smoking status - 2006-2010

Smoking Status	Prevalence (%)	Percent Attributable Fraction (95% CI) <sup>a</sup>
Current smokers	24.5	4.0 (2.3-5.5)
Former smokers		
who quit within the last 5 years	6.5	1.7 (0.7-2.7)
who quit more than 5 years ago	11.7	3.1 (1.3-4.8)
Total		8.8 (6.3-11.3)

<sup>a</sup>The sum of individual categories may not equal the total because of rounding. Bootstrapped 95% CIs are shown in parentheses

Smokers are likely to have much shorter life expectancy than never smokers. By age 65, a substantial portion of smokers who have suffered most from cigarette smoking may have died prematurely because of smoking-related diseases. To investigate the possible impact of smoking-attributable premature deaths on the estimated smoking attributable fraction, the second sensitivity analysis, Appendix Table 2, was conducted by limiting final samples to those aged 18-65. As hypothesized, by limiting the sample to a younger population, the smoking attributable fraction associated with current smoking increases from 3.2% in the primary analysis to 4.0%, while that of those who quit more than 5 years declines from 4.0% to 3.1%. The overall smoking attributable fraction, however, largely remain unchanged.

**Appendix Table 3.** Percent annual health care spending attributable to cigarette smoking, by smoking status and using a dichotomous variable for alcohol use - 2006-2010

Smoking Status	Percent Attributable Fraction (95% CI) <sup>a</sup>
Current smokers	3.1 (2.1-4.2)
Former smokers	
who quit within the last 5 years	1.4 (0.7-2.2)
who quit more than 5 years ago	4.0 (2.4-6.0)
Total	8.6 (6.6-11.1)

<sup>a</sup>The sum of individual categories may not equal the total because of rounding. Bootstrapped 95% CIs are shown in parentheses.

Since excessive alcohol use is a risky behavior that is closely correlated with cigarette smoking, the classification of alcohol use may affect the estimated smoking attributable fraction.

Therefore, a dichotomous alcohol use variable (current drinker vs. nondrinker) was used in the sensitivity analysis (Appendix Table 3) to explore the potential influence of the specification of alcohol use. These estimates suggest that the specification of alcohol use has limited impacts on our primary estimation.

**Appendix Table 4.** Smoking-attributable fractions and annual health care spending attributable to cigarette smoking, by payer - the 2010 MEPS

Payer	Percent Attributable Fraction (95% CI) <sup>a</sup>	2010 MEPS (\$ <sup>b</sup> billions, 95% CI)
Medicare	9.6 (4.4-15.6)	28.1 (27.8-28.4)
Medicaid <sup>c</sup>	15.2 (6.2-27.4)	13.4 (13.2-13.6)
Other federal <sup>d</sup>	32.8 (21.3-46.3)	14.7 (14.6-14.8)
Private insurance	5.4 (1.0-9.9)	22.8 (22.4-23.2)
Out-of-pocket	3.4 (0.6-6.0)	4.0 (3.9-4.0)
Others <sup>e</sup>	11.8 (0.0-23.9)	5.8 (5.7-5.9)
Total	-	88.8 (88.2-89.4)

<sup>a</sup>The sum of individual categories may not equal the total because of rounding. Bootstrapped 95% CIs are shown in parentheses.

<sup>b</sup>Dollar values were adjusted to 2010 using the Consumer Price Index for All Urban Consumers: Medical Care provided by the U.S. Bureau of Labor Statistics.

<sup>c</sup>Medicaid payments reported for persons who were not listed as enrolled in the Medicaid program at any time during the year.

<sup>d</sup>Other federal includes Tricare, VA health benefits, Indian Health Service, military treatment facilities, and other care provided by the federal government.

<sup>e</sup>Others include other state and local sources (community and neighborhood clinics, state and local health departments, and state programs other than Medicaid), other unclassified sources (automobile, homeowner's, liability, and other miscellaneous or unknown sources), and other public resources

**Appendix Table 5.** Annual health care spending attributable to cigarette smoking, by type of service - the 2010 MEPS

Type of Service	Percent Attributable Fraction (95% CI) <sup>a</sup>	2010 MEPS (\$ <sup>b</sup> billions, 95% CI)
Inpatient	11.1 (4.9-17.7)	35.2 (34.8-35.6)
Non-inpatient <sup>c</sup>	5.3 (2.1-9.0)	25.1 (24.7-25.5)
Rx drug	10.4 (6.3-13.6)	26.2 (26.0-26.4)
Total		86.4 (85.8-87.1)

<sup>a</sup>The sum of individual categories may not equal the total because of rounding. Bootstrapped 95% CIs are shown in parentheses

<sup>b</sup>Dollar values were adjusted to 2010 using the Consumer Price Index for All Urban Consumers: Medical Care provided by the U.S. Bureau of Labor Statistics

<sup>c</sup>Non-inpatient includes outpatient services, physician and clinical services, and other professional services

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